Treatment of Closed Head Injuries

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SUMMARY

Cerebral concussion is a physiological disturbance in the brain that follows a blow on the head. The cardinal symptom is a disturbance in consciousness varying from a complete loss of consciousness to a dazed state. The phenomenon is self-limited and completely reversible.

In cerebral contusion there is actual injury to the brain. The symptoms that result vary according to the amount and location of the damage. A very small amount of damage in certain areas of the brain may be fatal, while extensive damage in other areas will be survived.

Even when a patient is unconscious after a head injury, certain simple neurologic tests can be done to determine with some accuracy the extent and location of brain damage. When the patient regains consciousness, further bedside tests can be carried out to increase the accuracy of diagnosis.

Careful observation of the patient at frequent intervals is necessary to judicious application of appropriate treatment. The physician must be on the alert constantly for signs of intracranial hemorrhage and should be ready to intervene surgically if necessary.

In most cases of injury to the head, treatment consists of supplying to the patient elements that are necessary to maintain physiologic conditions and of combating disorders arising from specific injuries to the brain.

FORTUNATELY, in the care of patients who have so-called closed head injuries—the term is applied to any injury of the head in which there is neither penetrating wound of the skull nor compound or depressed fracture—surgical intervention is seldom required, although it should always be anticipated.

The most common of injuries to the head is cerebral concussion. This condition is simply a disturbance in the normal state of the brain caused by a blow on the head that is not severe enough to cause structural damage in the brain. The disturbance is self-limited and the patient needs no more than supportive measures. In this state, there is always some disturbance in consciousness that may vary from total unconsciousness lasting from minutes to several hours, to a transient clouding of the sensorium frequently termed a "dazed" or "punchy" state. Frequently the condition is associated with more or less shock.

A more serious but less frequent kind of head injury may be classified as brain contusion. Injury of this kind may or may not be associated with fractures of the vault or base of the skull. The outcome, barring certain complications, depends largely upon the amount and location of actual damage to the brain. A relatively small hemorrhage in the pons, for instance, may cause death quickly, while a very extensive contusion of a cerebral hemisphere may be followed by recovery.

The cardinal factors of interest to the physician are the kind and extent of the injury, and the proper treatment.

Proper clinical evaluation of the condition of the patient is of utmost importance in order to determine the kind and extent of brain injury, and for this there are several simple guides.

First, it is important to know how the patient was injured. If the injury occurred as the result of a blow to the head while the head was stationary—as might happen if the patient were struck by a blackjack or a baseball—the damage to the brain is likely to be fairly well localized to the zone of impact. On the other hand, if the head was moving rapidly and struck a solid object, extensive and diffuse brain damage is more probable.

The state of consciousness following an injury is extremely important to evaluate. Since it has been shown that a persistent loss of consciousness is due to minute lesions in the hypothalamus located near the center of the brain, it is apparent that deep and prolonged stupor is indicative of severe and extensive brain injury. In most instances, the loss of consciousness occurs at the time of injury and persists for varying periods afterward. Concussion is followed by loss of consciousness that may be very transient and followed by a period of confusion and disorientation persisting for several hours. If stupor has not begun to diminish two or three hours after injury, it is probable that cerebral concussion has been complicated by actual brain contusion. Each day that stupor or coma continues decreases the chance of recovery, although patients have survived even after as long as three months of unconsciousness. The disturbance in sensorium is frequently accompanied by amnesia which may persist for several days after the return to consciousness. Retrograde amnesia also is a frequent phenomenon; the patient may have no recollection of things that happened several hours before injury.

In some instances there may be a period of lucidity following a blow on the head which may or may not have caused immediate loss of consciousness, and then a lapse into deepening stupor. In an adult this usually indicates intracranial hemorrhage and is very serious. The phenomenon is much more com-

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mon in children, and generally a less serious sign, although here, too, bleeding must be suspected. If bleeding occurs the patient's condition will deteriorate and neurologic symptoms referable to the area affected by it will develop. Bleeding must be controlled promptly by surgical means. If stupor following an interval of lucidity is due to localized or generalized post-concussion cerebral edema, localizing signs are not prominent, the stupor is not deep and the patient's condition begins to improve in a relatively short time.

The temperature, pulse rate, respiration rate and blood pressure, in themselves, are generally unreliable as indices of the condition of the patient. This is particularly true of children, who may have a very rapid pulse and respiratory rate in the presence of increasing stupor and progressively prominent localizing neurologic signs. An adult patient with increasing intracranial pressure will have a slowing of the pulse and of the respiratory rate while the pulse pressure tends to increase, and at the same time there will be increasing headache, nausea, vomiting and progressively deepening stupor. If there is rapidly increasing temperature in the presence of other evidences of a severe head injury, the prognosis is generally very poor. In general it is a fallacy to judge the condition of the patient on the basis of the pulse rate, respiration rate and blood pressure alone.

In conjunction with the observation of the general signs already noted, it is important to consider the presence of localized brain damage. A limited neurologic examination of an unconscious patient can be done in a very few minutes. The head should be palpated carefully and x-ray films taken if necessary to determine whether or not depressed skull fracture is present. Frequently, the skull can be seen or palpated through a scalp laceration. If a depressed skull fracture is present, special attention is, of course, necessary. The pupils of the eyes must be examined and the reaction to light observed. If one pupil is static, ipsilateral brain compression or contusion must be suspected. If both pupils are dilated and do not respond to light, it is probable that there is bilateral and extensive brain damage, and the prognosis is generally very poor. Although the extraocular muscle function cannot always be determined with accuracy, a fair appraisal can be made by careful observation of the roving motions of the eyes in all directions. If the third, fourth or sixth cranial nerve has been damaged on either side, the limitation of motion of the eyeball is evident. If there is a fixed conjugate deviation of the eyes to one side, localized cortical damage must be suspected. Examination of the ear canals should be carried out. Bleeding through a ruptured ear drum is indicative of basal skull fracture in the middle fossa. If there is discharge of blood from the nose, the source of bleeding should be determined, if possible, since nasal hemorrhage without evidence of injury to the nose usually occurs as a result of a basal fracture through the floor of the anterior fossa of the skull.

Facial asymmetry, if present, is usually evident as an unconscious patient becomes restless. If the stupor is deep, firm supraorbital pressure is frequently a stimulus painful enough to cause the patient to move the muscles of expression on one or both sides of the face. Supraorbital pressure is also a useful test in determining the relative depth of the stupor. Subarachnoid hemorrhage may occur without causing any indication of meningeal irritation for a number of hours after an injury has occurred. However, in almost all such cases there will be some stiffness of the neck after 12 hours. Also there may be positive reaction to Kernig's test, but in general this test is a little less reliable than a determination of the stiffness of the neck.

A few minutes of observation of a patient who is restless will serve to determine whether or not both sides of the body are being used with equal frequency and equal force. If motions on one side are less frequent, one must suspect local brain contusion and be alert to detect progressive paralysis of the side that is used least frequently. The withdrawal response to painful stimuli, such as plantar stimulation or deep pressure over the nail bed, also helps in determining the relative strength on the two sides. The tone of the extremities should also be noted to determine if there is any difference in tone on the two sides of the body. It is just as important to observe differences in flaccidity between one side and the other as it is to note greater rigidity. The deep and superficial reflexes should be evaluated carefully and the activity on one side compared with that on the other. Ankle clonus can be easily tested and the sole of the foot should be stroked to determine whether or not Babinski reflexes are present. Usually by carrying out these simple tests, it is possible to determine whether or not any brain damage has occurred and, if so, whether the damage is bilateral or unilateral. At times, one can go a step further and determine whether or not the damage is chiefly in the anterior, the central or the posterior area of the cerebral hemisphere.

If the patient is conscious, a more thorough neurological examination can be done. The various special senses can be tested, including the visual fields. This can be done easily with a so-called confrontation test. The test is carried out in a very few minutes by checking one eye at a time and having the patient fix his gaze on the examiner's forehead or nose. The examiner can then bring either his finger or some other small, easily seen object in from the periphery of the four quadrants of the visual fields. By this test the size, shape and location of visual defect can be determined. When the extraocular muscle functions are examined, the patient should be instructed to keep his gaze fixed on the examiner's finger, which then is moved from side to side and up and down. The failure of either eye to follow is readily apparent and at the same time the presence of nystagmus can also be observed. The corneal reflexes are simply tested by a sharp, short puff of breath directed against each cornea.

Forced and emotional movements of the face should be observed for symmetry and each side of the face should be tested for sensory acuity. The response to pin-prick will generally indicate areas of sensory impairment.

Hearing, of course, can be easily tested, preferably with a tuning fork. It is important to examine hearing as early as possible after the injury, for several reasons. Occasionally, a person with a basal fracture of the skull will have loss of hearing without bleeding from the affected ear canal simply because the ear drum has not ruptured and the blood accumulates in the middle ear. (Also, in industrial and liability cases, hearing sometimes suddenly disappears in one ear shortly after legal proceedings are instituted.) The mouth and throat should be inspected and any asymmetry in the tongue or palate noted.

Careful appraisal of the patient's speech is important. Even though the patient may be confused and irrational, various types of aphasia may be detected. Sometimes complete motor aphasia or nominal aphasia is falsely attributed to some degree of stupor or to psychic disturbance. A simple test for nominal aphasia is to ask the patient to identify a watch, a fountain pen or a box of matches.

A test of the sensory facilities should be done as soon as possible after the patient regains consciousness. Total anesthesia of one or more extremities does not occur as the result of brain damage. Frequently, however, there may be loss of one or more of the special types of sensation. For example, the stereognostic sense may be completely lost in one hand while other kinds of sensation are preserved. The stereognostic sense is tested by asking the patient to identify, without looking, a common object placed in his hand. If the stereognostic sense is disturbed, there is frequently also some disturbance in position sense. Varying degrees of disturbance in tactile sensibility, as evidenced by reaction to light touch or pin-prick on the face, trunk and extremities, may be present. The best results will be obtained from the sensory examination if the tests are done with the patient's eyes closed. Finer tests for muscle coordination should also be done with the patient's eyes closed. The finger-to-nose test and the heel-to-knee test can be easily carried out, and both are very informative.

To summarize the foregoing discussion of signs and symptoms: It may be assumed that the patient is doing well if the pulse, respirations, temperature and blood pressure are not fluctuating, if stupor is lessening and if there is no progression in the neurologic signs. On the contrary, if the stupor is deepening, the pulse, respirations and blood pressure are fluctuating and there are signs of progressive central nervous system dysfunction, the patient's condition is deteriorating and unless something can be done to change the sequence of events, the outcome probably will be fatal.

After the status of the central nervous system has been thoroughly evaluated, other associated injuries must be considered. If there is fracture of the extremities, at least emergency splinting must be done even in cases in which the head injury is severe, although whether or not to begin definitive treatment of complicated fractures depends, of course, upon the condition of the patient. The examiner ought also to attempt to determine whether or not there are any visceral injuries.

There are a few special procedures that are necessary to ascertain the condition of the patient soon after the head injury has occurred. If for any reason there is doubt regarding the presence of brain contusion, a spinal puncture should be done. The spinal fluid pressure should be measured with a manometer and the character of the fluid noted. If brain contusion has occurred, the fluid is usually blood-tinged or frankly bloody and there may be an increase in intracranial pressure. If the spinal fluid is clear and the pressure high, great care should be exercised in the withdrawal of more than a few drops of spinal fluid. In the absence of depressed fractures or penetrating wounds of the skull, the taking of x-ray films is not ordinarily necessary as an emergency procedure. In most instances, it is desirable to defer routine x-ray examination of the skull until the general condition of the patient is reasonably stable. In most instances, if a depressed fracture or a linear fracture crossing the middle meningeal channels in the temporal bone is present, it is observable in a scout film taken with a portable x-ray unit.

The use of electroencephalograms, pneumoencephalograms and angiograms is not necessary in the acute stage of head injury. Such examinations, however, are valuable in evaluating some of the post-traumatic states and late complications that occasionally occur.

TREATMENT

Treatment of acute head injury is usually started by treatment of the initial shock. Infusion of glucose solution, blood plasma and whole blood, administration of oxygen and stimulants and the application of external heat must be carried out irrespective of the head injury. After the initial phase of shock has subsided, and the type and extent of damage to the nervous system has been determined, more definitive treatment can be instituted.

One of the most troublesome symptoms is restlessness. That which is caused by cortical irritation alone is not common except in alcoholic patients, and usually there is good response to paraldehyde given by mouth or rectally. Some physicians give the drug intramuscularly and a few intravenously without apparent deleterious effects. In most instances, restlessness is due to pain and discomfort. This can be combated by adequate splinting of fractures, by comfortable positions in bed, by catheterization if the bladder is over-distended, and by giving appropriate analgesics. Codeine is probably the most helpful drug for the control of pain. Demerol® in doses not to exceed 100 mg. hypodermically, every three or four hours, may be used. Morphine, Pantopon® and Dilaudid® are not usually desirable

because of the depressing effect of these drugs on the respiratory mechanism, although they are usually tolerated well by persons with minor head injuries.

The routine use of chemotherapy and antibiotics is not justifiable. If the patient obviously has infection of the sinuses or ears and there has been a basal skull fracture with bleeding into the infected area, the necessity for antibiotics is apparent. In most cases, however, such therapy is not used prophylactically but is reserved until there is some evidence of the beginning of infectious process.

Enough fluid to maintain normal fluid balance should be given—a minimum of 1,500 cc. Usually five or ten per cent solution of glucose and water suffices. Except for cases in which there is a long period of unconsciousness, the maintenance of normal protein intake is usually not a problem. If it is apparent that the patient is going to have a very long period of stupor, a stomach tube can be used to insure adequate supplies of proteins and carbohydrates and electrolytes.

If the patient is unconscious, care must be taken to assure a free airway. The optimum position for the unconscious patient is a modified Sim's position to allow free drainage of secretions from the nose and throat. If this is not adequate, pharyngeal suction is necessary, and in some instances it is necessary to insert an intratracheal tube to facilitate aspiration of the bronchial tree. If an intratracheal tube is not practical, an intratracheal catheter can usually be inserted without difficulty in a deeply stuporous patient.

Oxygen therapy is of considerable value in all cases of serious head injury. As an emergency measure, a nasal catheter is more desirable than an oxygen mask. An oxygen tent with adequate refrigeration is usually very well tolerated after the patient has stabilized. In all cases, it is very important to humidify the oxygen adequately.

It is necessary to be continuously on the alert for rapid increases in the patient's temperature. Routinely, specific measures should be instituted before the rectal temperature reaches 104°. Ice bags on the head, axillae and groins should be used freely. Continuous administration of cooled and humidified oxygen is essential. Tepid sponges, sponges with ice water or with chilled alcohol are helpful. If the temperature is very high or is rising rapidly, so drastic a measure as sponging with ether is justified. In such an emergency, some measures are usually necessary to reduce intracranial pressure. If the pressure is elevated due to generalized cerebral contusion and edema, 50 per cent glucose solution given intravenously in 100 cc. doses may be helpful. Curiously, blood plasma seems equally beneficial. Spinal puncture may be done for transient reduction of intracranial pressure. If a rise in temperature is accompanied by progressive focal neurologic signs, it is because localized bleeding has occurred. and surgical intervention then is necessary.

In recent years, early ambulation has been prescribed for patients with injury of the head. In general, the author permits patients to become ambulatory as soon as they can be up and about without exaggeration of existing symptoms or production of new symptoms.

Certain complications of head injury must be kept in mind during the convalescent period. These include epidural or middle meningeal hemorrhage, acute and chronic subdural hematoma, intracerebral hemorrhage or so-called late traumatic apoplexy. delayed subarachnoid hemorrhage, convulsive seizure due to localized cortical cicatrix, and the very annoying but self-limited post-traumatic syndromes.

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